INSTRUCTIONS

GE Industrial Control Systems

6KBU300

Braking Unit

6KBU300 Braking Unit

Instruction Manual

This book replaces the Instruction Book GEI-100350A Rev. 1.0 (9/97)

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CONTENTS

1. GENERAL

The braking unit 6KBU300 is basically composed by a static switch (IGBT) controlling the voltage of the intermediate circuit of the inverter (DC Link), dissipating the energy generated by the motor (and correspondent load) connected to the inverter while deceleration steps, by turning on and channeling excess energy through a resistor.

With this technique it is possible to obtain faster decelerations, operate overhauling loads avoid the tripping of the "Overvoltage" protection of the inverter, which could be caused by a sudden increasing of the DC Link voltage.

Through a parallel connection of the units between terminals C and D, and a cascade connection of the braking command (master/slave configuration), it is possible to parell four-units in connection.

A thermal protection contact input of the braking resistor with latched alarm is provided.

The latched alarm can be reset, once the alarm condition has been eliminated, by means of the button present on the unit, or by a remote command, or switching off and on again the braking unit.

A quick discharge of the inverter's intermediated circuit (DC Link) can be commanded.

This command must be directly interblocked with the contactors that supply the energy to the inverters and suitably interlocked to not discharge while the drive is enabled.

2. MAINS CHARACTERISTICS

- Protection IP20
- Max. working temperature 40°C (104°F) ambient (max 50°C (122°F) with a 20% of derating)
- Costant switching on time (max. time ON) 3 minutes
- Max.duty cycle admitted 50%
- Supply of the circuit obtained by the DC Link
- Possibility of parallel connection up to 3 units managed by a "MASTER" unit (4 slave units managed by a drive set as master)
- DC Bus threshold set by dip switches
- Signaling of the +24V supply presence (Green diode led +24V)
- Signaling of the Brake unit activity (Yellow diode led BR)
- Signaling of alarm condition AL (Red diode led AL)
- Signaling of OK condition (Green diode led OK)
- OK relay dry contacts available for alarm sequences
- Input to connect a resistor mounted klixon contact
- Possibility of quick discharge of the DC Link.

3. TECHNICAL DATA

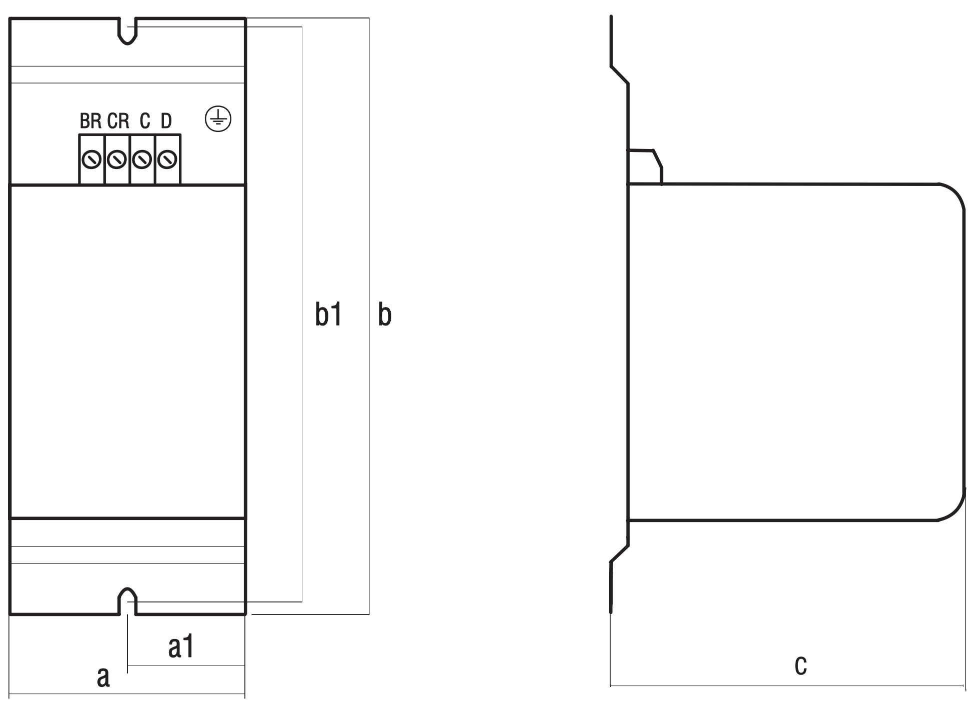
Model	Dissipated power @ Full load	Peak current	Average current
6KBU300-20	130 W	50 A	20 A
6KBU300-50	300 W	100 A	50 A
6KBU300-85	400 W	170 A	85 A

bu0005

WARNING! The electronic circuit of the braking unit is directly connected to the DC Link whose voltage value can reach up to 770Vdc.

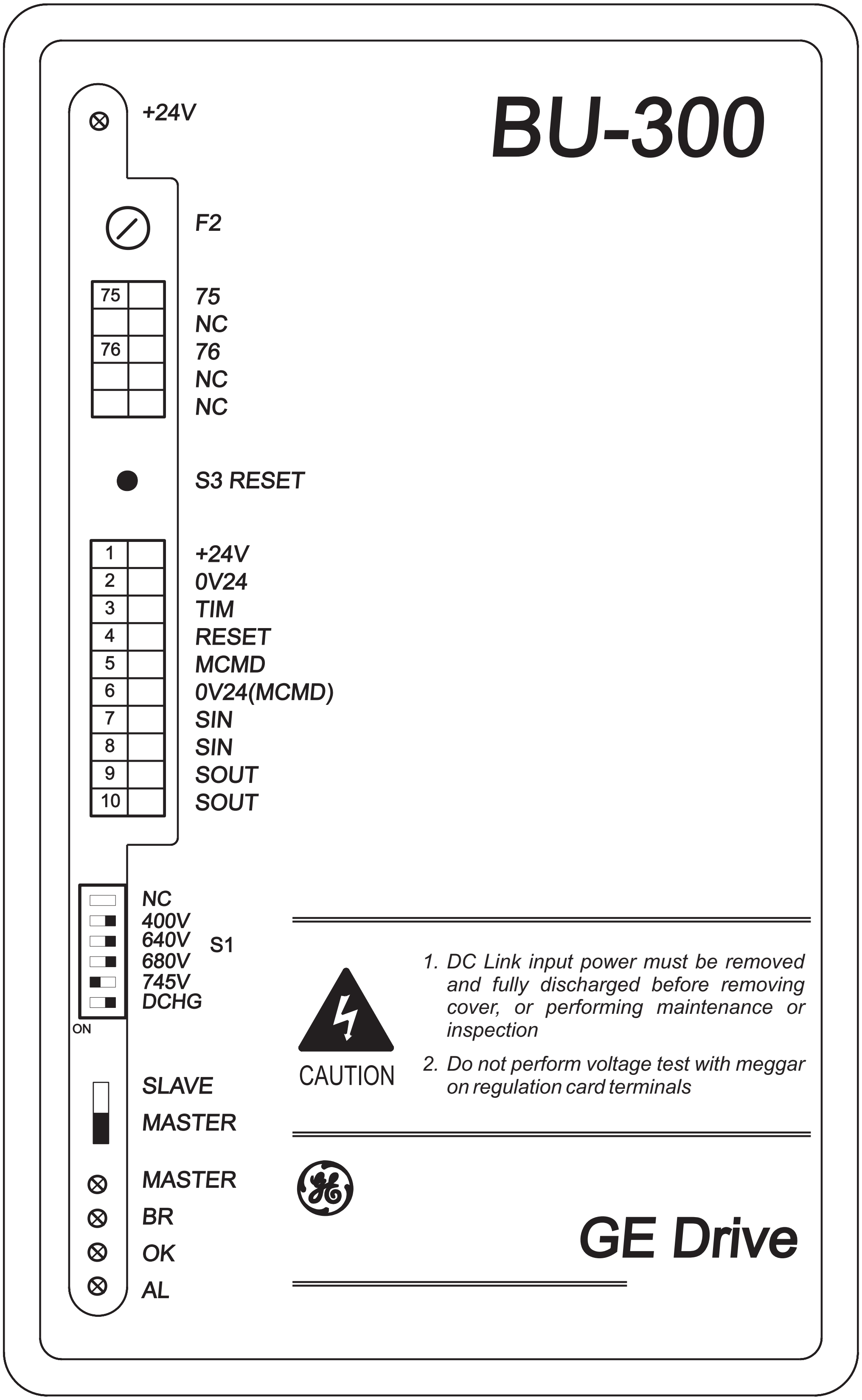
When the cover of the drive is not removed, the live parts are not accessible (IP 20)

3.1. DIMENSIONS AND WEIGHTS



Model	a in/mm	b in/mm	c in/mm	a1 in/mm	b1 in/mm	∅	lbs/Kg
6KBU300-20	5.7/144	12.6/320	8.27/210	2.8/71	12.1/307	M 6	11.5/5.2
6KBU300-50	5.7/144	12.6/320	8.27/210	2.8/71	12.1/307	M 6	12.5/5.7
6KBU300-85	5.7/144	12.6/320	11.1/280	2.8/71	12.1/307	M 6	15/6.8

bu0045


+24V
BU-300
F2
75
76
75
NC
76
NC
NC
S3 RESET
1
2
3
4
5
6
7
8
9
10
+24V
0V24
TIM
RESET
MCMD
0V24(MCMD)
SIN
SIN
SOUT
SOUT
NC
400V
640V
680V
745V
DCHG
S1
ON
CAUTION
1. DC Link input power must be removed and fully discharged before removing cover, or performing maintenance or inspection
2. Do not perform voltage test with meggar on regulation card terminals
SLAVE
MASTER
MASTER
BR
OK
AL
GE Drive

Front view

3.2. HARDWARE SPECIFICATIONS

3.2.1. Power required

The supply of the braking unit is directly obtained by the DC Link and the maximum consumption is 15W.

3.2.2. Internal fuses

Denomination	Protection for	Fuses
F1	Switching input supply	4A 500V slow 6 x 32 mm
F2	+24V supply (terminals 1 and 2) Master output command (terminals 5 and 6)	315mA 250V slow 5 x 20 mm
F3	Supply of the internal fan (+24V)	1A 250V slow 5 x 20 mm

bu0015

The fuse F2 for the +24V supply (terminals 1 and 2) and Master output command (terminals 5 and 6) is mounted on the front panel.

Replacement vendor sources:

Fuse 1 - Omega (Europe) GF632240

Fuse 2 - Omega (Europe) ST520131

- Littlefuse 218315

Fuse 3 - Omega (Europe) ST520210

- Littlefuse 218001

3.2.3. Signalling LEDs

Denomination	Colour	Function
24 V	green	It shows presence of the power supply
MASTER	yellow	The braking unit is set as master
BR	yellow	The braking unit is active (braking)
OK	green	OK relay status (closed = OK)
AL	red	It shows the alarm condition

bu0020

3.2.4. Terminal strip

The power terminal strip is composed by the following terminals:

Terminals	Function	I/Q	Volt. max.	Curr. max.
C	Connection to the intermediate circuit of the inverter	I	770Vdc	I peak
D	Connection to the intermediate circuit of the inverter	I	770Vdc	I peak
CR	Connection to the braking resistor	Q	745V dc	I peak
BR	Connection to the braking resistor	Q	745V dc	I peak
PE	Ground connection	–	–	–

bu0025

Regulation board terminal strips:

Terminals	Name	Function	I/Q	Volt. max.	Curr. max.
1	**+24V**	Supply for commands TIM-RESET	Q	24V	200mA
2	**0V 24V**	0V potential of the +24V supply		–	–
3	**TIM**	Connection for the thermal contact of resistor protection	I	15...30V	3.2...6.4 mA
4	**RESET**	Remote Reset of alarm condition	I	15...30V	3.2...6.4 mA
5	**MCMD**	Slave unit command (Master output)	Q	24V ± 5%	30 mA
6	**0V 24V**	0V potential of MCMD command		–	–
7	**SIN**	Slave unit input command	I	8...30V	16 mA
8	**SIN**	Slave unit input command	I	8...30V	16 mA
9	**SOUT**	Cascade connection of Slave units	Q	8...30V	16 mA
10	**SOUT**	Cascade connection of Slave units	Q	8...30V	16 mA
75	**OK**	OK relay dry contact (closed = OK)	Q	250Vca	1 A
76	**OK**	OK relay dry contact (closed = OK)	Q	250Vca	1 A

bu0030

Maximum cable sizes for power terminals C,D,CR,BR

Braking Unit type	Maximum Permissible Cable Cross-Section		
	[mm^2]		AWG
	flexible	multi-core	
6KBU300-20	10	10	12
6KBU300-50	16	16	10
6KBU300-85	35	35	2

bu0031

Maximum cable sizes of the regulation section terminals

Terminals	Maximum Permissible Cable Cross-Section		
	[mm^2]		AWG
	flexible	multi-core	
1 ... 76	0.35 ... 1.5	0.35 ... 1.5	22 ... 16

bu0032

3.2.5. Dip Switches description

Denomination	Function				
S1-1	Enabling of the function for quick discharge of the DC link Standard = OFF				
S1-2 ... S1-5	Selection of intervention threshold of the braking unit				
	Braking threshold	S1-2	S1-3	S1-4	S1-5
	400V dc	OFF	OFF	OFF	ON
	640V dc	OFF	OFF	ON	OFF
	680V dc	OFF	ON	OFF	OFF
	745V dc	ON	OFF	OFF	OFF
S1-6	Not used				
S2	MASTER = Selection of braking unit function as Master (standard) SLAVE = Selection of braking unit as Slave				
S3	Button Reset of alarm condition				

bu0035

3.3. SELECTION OF THE INTERVENTION THRESHOLD

The DC threshold of the braking unit must be set accordingly to the supply voltage value of the connected inverter, setting the switches as described in the following table.

NOTE: It is possible to select only one braking threshold at a time.

Voltage supply	**Braking threshold [V_{BR}]**	**Position of the switches**			
		S1-2	**S1-3**	**S1-4**	**S1-5**
230Vac	400Vdc	OFF	OFF	OFF	**ON**
400Vac	680Vdc	OFF	**ON**	OFF	OFF
460Vac	745Vdc	**ON**	OFF	OFF	OFF

bu0010

3.4. PARALLEL CONNECTION OF THE UNIT

There is the possibility to connect up to four braking units in parallel. For this purpose, terminals C and D must be parallel connected and one of the units must be set as Master function, while the others as Slave (through switch S2).

Only the Master needs to be selected for the desired intervention threshold (through switches S1-2...S1-5).

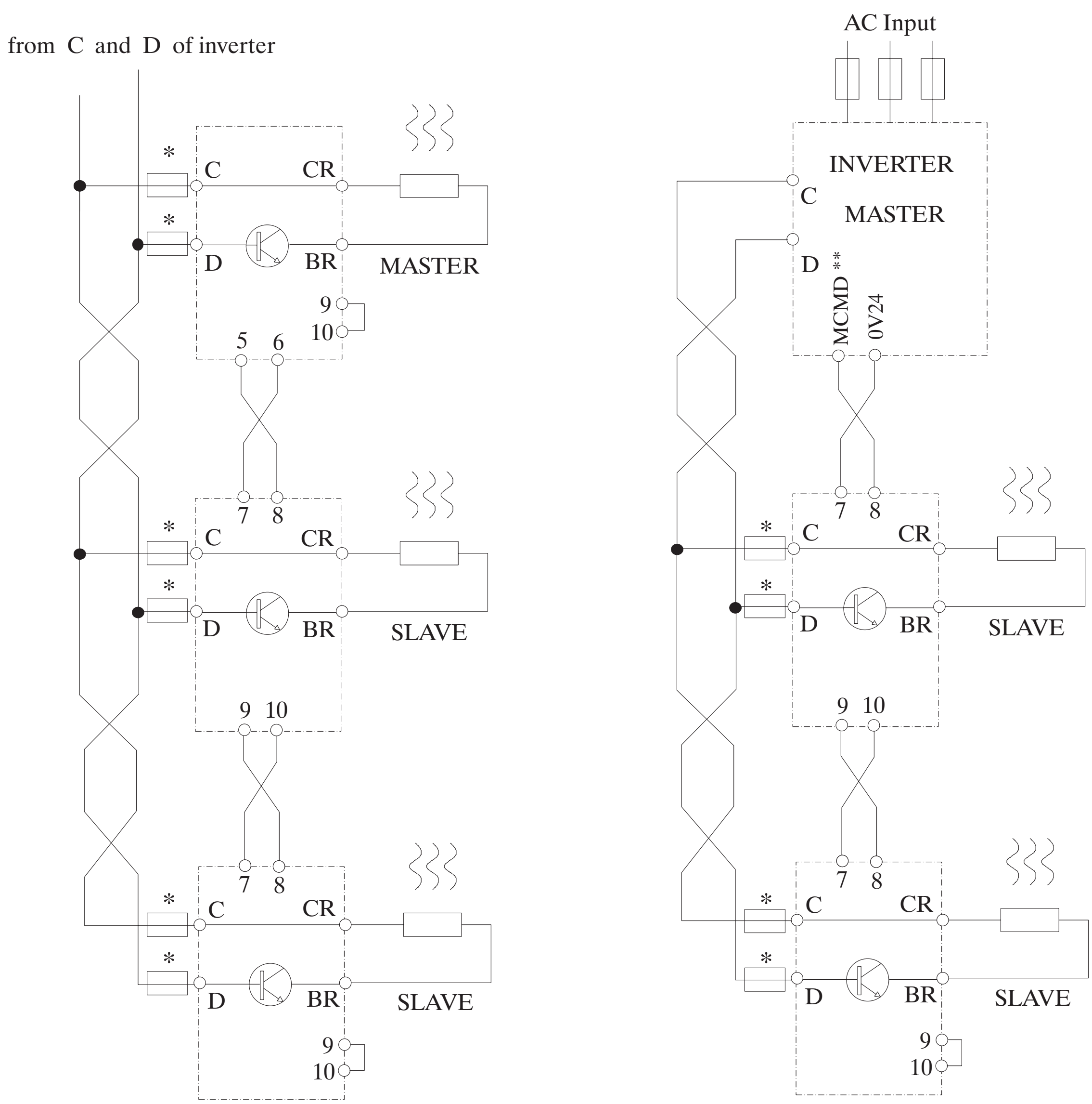
Connect the braking units as showed in the picture, paying particular attention to the correspondance of the terminals connection C and D. For the cascade's command connections (terminals 5 ... 10) correspondence of terminals polarity is not requested, but it is advisable to use twisted cables.

In this configuration, when the Master unit reaches the set intervention threshold, it manages also the intervention of the first Slave unit by means of the command MCMD (output terminals 5 and 6), which is cascade connected to the input SIN of it (terminals 7 and 8). At its turne, the second Slave will be enabled by the command SOUT (output terminals 9 and 10) of the first Slave.

In case of inverters provided with internal command for external brake units, all the 6KBU300 units must be set as Slave. The terminals MCMD and 0V24 of the drive have to be connected to the terminals 7 and 8 (SIN) of the first 6KBU300, which will be of course connected to the next through its own terminals 9 and 10 (SOUT), as described in the next page.

NOTE: When a very close mounting of several braking units is needed, it is necessary to keep among them a minimum distance of 5 centimeters (2 inches).

NOTE: WRONG CONNECTIONS OF THE POWER PART CAN CAUSE THE DESTRUCTION OF THE UNIT AND/OR OF THE CONNECTED INVERTERS IF DC LINK FUSES ARE NOT SUPPLIED !!



* If supplied (see section 7)
** MCMD terminal is available only for Drives having "Product configuration C1" or higher

Example of three units connected in parallel through 6KBU300 or inverter Master

The max. lenght of the connections between braking units and inverters must not exceed two meters, (the twisted connection with the appropriate wire section, is always supplied together with the braking unit).

For the parallel connection of braking units, the user must always use a twisted cable; the units should however be mounted side by side and the connections between terminals C and D should be kept as short as possible.

The power fuses of the correspondent inverters must be super fast.

3.5. OVERTEMPERATURE ALARM.

When the braking resistor reaches too high temperature, there is the possibility to trip out the braking unit. This happen by means of the thermal relay (Klixon), and connecting its contact (normally closed) between the output +24V (terminal 1) and the input protection TIM (terminal 3).

The contact of the thermal relay can be also externally supplied with a voltage between 15 and 30V whose 0V potential must be connected to the 0V24V (terminal 2).

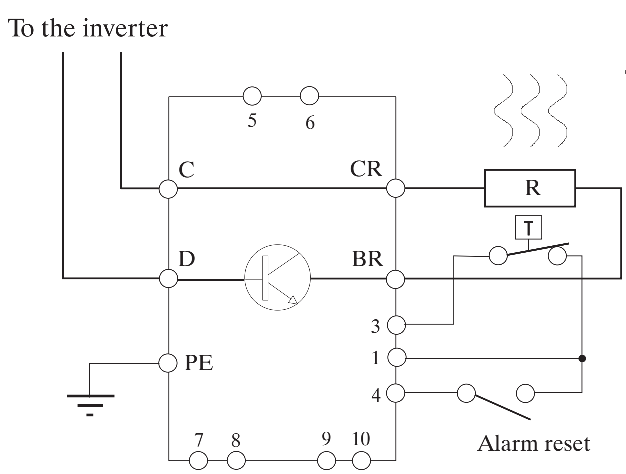
When there is the intervention of the thermal relay (opening of the contact) the braking unit is immediately tripped , the red led AL lights on and the OK relay contact opens (terminals 75 76).

When an Overtemperature alarm occurs due to an overheating of the power module’s heatsink (opening of the relative thermal relay), a BU trip occurs.

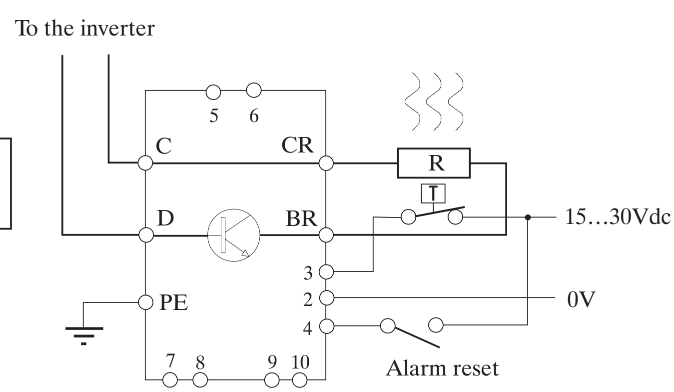
Once the alarm has been eliminated, it is possible to reset the braking unit using one of these modalities:

- through button S3
- through remote command inserted on the terminal 4
- removing BU from DC BUS

The diagrams in the following pictures show a typical connection for protection with an external contact for the alarm reset.



Using the internal power supply of the braking unit



Using external power supply from the unit

3.6. USE OF DC LINK DISCHARGE FUNCTION

The braking unit can be used for discharging of DC Link with high capacitive value (e.g. in systems where the DC Link is parallel connected) by a dipswitch setting.

In order set the switch S1-1 in position ON and bridge terminals 9 and 10.

In this condition the discharge of DC Link is obtained up to a value equal or lower than 60Vdc, applying an external voltage between 10 and 30Vdc to the terminals 7 and 8 (SIN) or using the internal voltage present at the terminals 1 and 2.

In order to avoid damages to the braking resistor, the user must pay particular attention to the insertion sequence of this command. The signal must be supplied to the braking unit through an interblocked contact with the contactors that supply the inverters.

4. DIMENSIONING OF THE BRAKING UNIT AND CORRESPONDING RESISTOR

What below indicated should be meant in general, because point 6 reports a list of the normalised resistor which must be used with the braking units of the series 6KBU300-.. for the supposed conditions.

Taking into account that:

P_{PBR} [W]	Peak power while braking
P_{NBR} [W]	Rated power of the resistor
E_{BR} [J]	Braking energy
V_{BR} [V]	Braking voltage threshold
I_{PBR} [A]	Peak braking current
I_{AVBR} [A]	Average braking current
I_{PBU} [A]	Peak current of the braking unit
n_1, n_2 [RPM]	Initial and final speed
t_{BR}, T [S]	Braking time and cycle time
J_{TOT} [Kg* m2]	Total moment of inertia (referred to the motor shaft)

We will have:

$$P_{PBR} = J_{TOT} * n_1 * \frac{n_1 - n_2}{t_{BR}} * \frac{2\Pi}{60} \quad \text{f001}$$

$$E_{BR} = \frac{J_{TOT}}{2} * \left(\frac{2\Pi}{60}\right)^2 * (n_1^2 - n_2^2)$$

$$I_{PBR} = \frac{P_{PBR}}{V_{BR}} \quad \text{f003}$$

Ohmic value of the resistor:

$$R_{BR} = \leq \frac{V_{BR}}{I_{PBR}} \quad \text{f004}$$

Rated continuous power of the resistor:

$$P_{NBR} = \frac{P_{PBR} * t_{BR}}{2T} = \frac{E_{BR}}{T} \quad \text{f005}$$

Attention! *The value calculated here has to be considered carefully:*

the formula calculates an <u>average</u> power value which may be considerably different from the istantaneous power in case of very low duty-cycles.

Normally, resistors are not able to sustain a peak power greater than 5 to 10 times their rated power. For this reason if the duty-cycles are less than 10%, the value calculated here can not be used as rated power of the resistor and considerations made at 4.1 and 6 have to be taken into account. Consult your resistor manufacturer for overload capability of resistors.

Being normally n2 = 0 (stop), we will have that:

$$E_{BR} = \frac{1}{2} P_{PBR} * t_{BR}$$ f006

Braking unit features: $I_{PBU} \geq I_{PBR}$ f007

This means that the peak current admissible by the 6KBU300-... must be equal or higher than the effective one. Then for the average current we will have:

$$I_{AVBR} = \frac{E_{BR}}{t_{BR} * V_{BR}}$$ $I_{AVBU} \geq I_{AVBR}$ f008

Sample calculation

Data:

- AC Input voltage		3 x 460 V
- Drive model		6KAV3015
- Rated motor power	(P_M)	15 HP
- Rated motor speed	(n_n)	3515 rpm
- Moment of inertia of the motor	(J_M)	0.033 kgm^2
- Moment of inertia loading the motor shaft	(J_L)	0.95 kgm^2
- Friction of the system	(M_S)	10% of motor nominal torque
- Initial braking speed	(n_1)	3000 rpm
- Final braking speed	(n_2)	0 rpm
- Braking time	(t_{BR})	10 sec
- Cycle time	(T)	120 sec

We will have:

$J_{TOT} = J_M + J_L = 0.033 + 0.95 = 0.983\ kgm^2$ and

$\Delta\omega = [2\Pi * (n_1 - n_2)] / 60\ sec/min = 2\Pi * 3000 / 60 = 314\ sec^{-1}$

Rated motor torque:

$M_M = P_M / \omega_n = (15 * 745.7) / (2\Pi * 3515 / 60) = 30.4\ Nm$ it follows that

$M_S = 0.1\ M_M = 3.04\ Nm$

The braking energy is given by:

$E_{BR} = (J_{TOT} / 2) * (2\Pi / 60)^2 * (n_1^2 - n_2^2) = (0.983 / 2) * (0.10472)^2 * 3000^2 = 48509$ Joules or Wsec

But, if we want to take into account also the friction of the system, the braking energy that the braking unit will need to dissipate is lower. To do this we can calculate E_B as follows:

The required braking torque is

$M_b = (J_{TOT} * \Delta\omega) / t_{BR} = 0.983 * 314 / 10 = 30.9$ Nm

In reality the friction torque "helps" the motor, so we obtain

$M_{bM} = M_b - M_S = 30.9 - 3.04 = 27.86$ Nm

The brake process average power is given by

$P_{AVE} = (M_{bM} * \Delta\omega) / 2 = 27.86 * 314 * 0.5 = 4374$ W

And the new value of braking energy that we obtain in this way is

New $E_{BR} = P_{AVE} * t_{BR} = 4374 * 10 = 43740$ Joules or Ws

which is obviously lower than the previous one.
The peak braking power is given by

$P_{PBR} = (J_{TOT} * n_1 * \Delta\omega * 2\Pi) / (t_{BR} * 60) = 9.7$ kW then we continue with
$I_{PBR} = P_{PBR} / V_{BR} = 9700 / 745 = 13$A and

$R_{BR} \leq V_{BR} / I_{PBR} = 745 / 13 = 57\ \Omega$

Being $I_{PBR} = 13$A, here we can already see that the unit **6KBU300-20** covers our needs. Now we have to choose the resistor:

The nominal power of the resistor has to be

$P_{NBR} = (P_{PBR} * t_{BR}) / 2T = (9700 * 10) / 240 = 404$ W

As we can see, the nominal power of the resistor is relative low due to a low duty-cycle (10 / 120) but the resistor must be able to withstand the energy that is applied to it during the 10 seconds of braking. This energy is 43740 Joules. If we go on the table of normalized resistors, the type BRR 1K0T 49R has a nominal power that would be sufficient but the value of E_{BR} is too low (21kWsec).

For this reason our final choice is the type **BRR 1K3T 31R** that has E_{BR} = 44kWsec.

4.1. SIMPLIFIED DIMENSIONING OF THE RESISTOR

In case all the above mentioned data were not available, it is possible to carry out the braking resistor calculation in a simplest but approximately way.

This solution can lead to an overdimensioning of the resistor which has to be used.

For the calculation of different resistor values (to use e.g. with different threshold intervention values of the braking unit) it is possible to use the following formula:

$$R_{BR}\,[\Omega] = \frac{V_{BR}\,[V]}{I_{PBU}\,[I]}$$

f011

Where “$\mathbf{V_{BR}}$” means the intervention threshold of the braking unit and “IPBU” the max. peak current described in the table.

Needing to calculate the value of the resistor for an inverter 6KAV3037 (100A peak current for the braking) supplied with 400V (intervention threshold 680V with S1-3 ON) we will have:

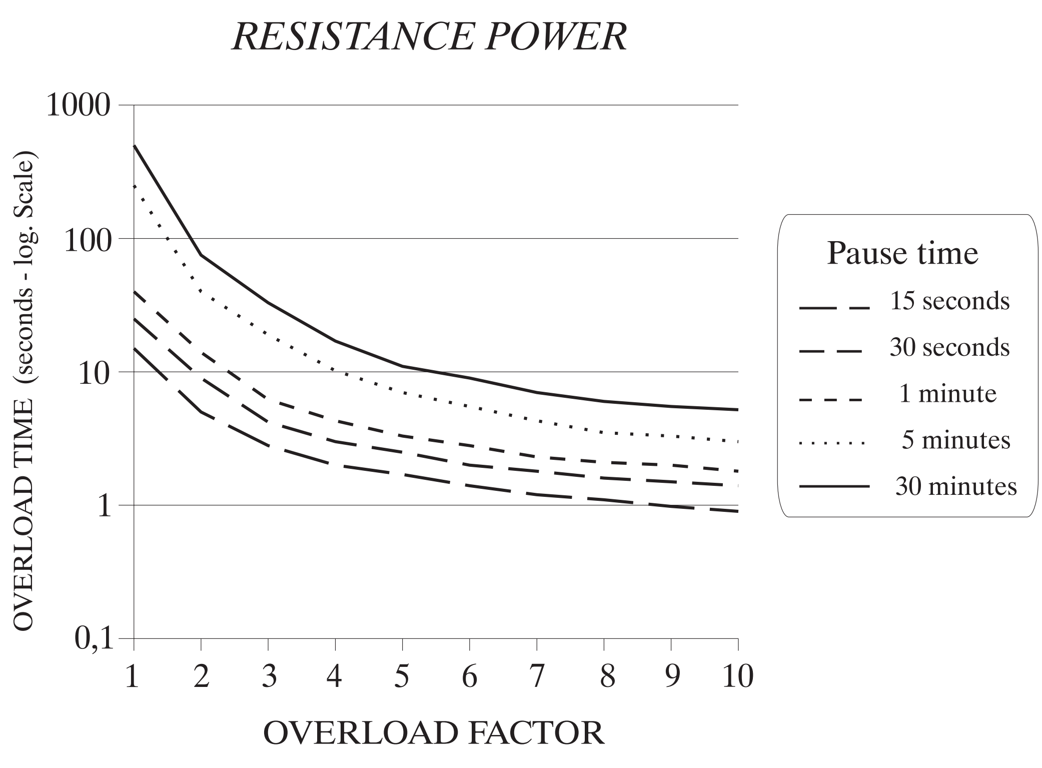
$$R_{BR} = \frac{680}{100} = 6{,}8 \text{ ohm}$$

f012

This formula shows the ohmic value, while about the resistor power the following consideration have to be taken into account.

The braking resistor is normally used with intermittent cycle; it will be possible in this way to use a resistor able to dissipate a costant power lower than the one given by the product $R_{BR} * I_{PBR}{}^2$.

To decide the overload factor the following diagram can be used (such diagrams can be supplied from the manufacturer of the resistor to use).



To calculate the value of the costant power (or rated) of the braking resistor using this graphic, it will be possible to apply the following formula:

$$\text{continuative power } R_{BR} = \frac{\text{regenerated power}}{\text{overload factor}}$$

f013

Considering having to brake a 30KW motor with overload of 150%, the regenerated power will be at maximum 45KW.

Supposing a braking time of 5 seconds (overload time for the resistor) and 1 break minute, the graphic provides an overload factor of 3,9, so the rated power of the resistor will be:

$$\frac{45000}{3.9} = 11.5 \text{ kW}$$

f014

NOTE: The use of the normalized resistors reported at chapter 6 it is strongly reccomended

5. MINIMUM VALUE OF THE RESISTORS THAT CAN BE USED

Model	**Value of intervention threshold**			
	400V	640V	680V	745V
	Minimum value of resistors			
6KBU300-20	10 ohm	16 ohm	17 ohm	18.6 ohm
6KBU300-50	4 ohm	6.4 ohm	6.8 ohm	7.5 ohm
6KBU300-85	2.4 ohm	3.7 ohm	4 ohm	4.4 ohm

bu0040

The ohmic value indicated in the table, represents the **absolute minimum value** of the resistor connectable to the different braking units in correspondence of the braking threshold set.

In case these values would not be available, it might be possible to use **higher** ohmic values.

E.g. with the braking unit 6KBU300-20 used with intervention threshold of 680V the indicated resistor value is 17Ω, if the commercial available ohmic value is 18Ω, it will be allowed its use with no problem (don't use 16Ω).

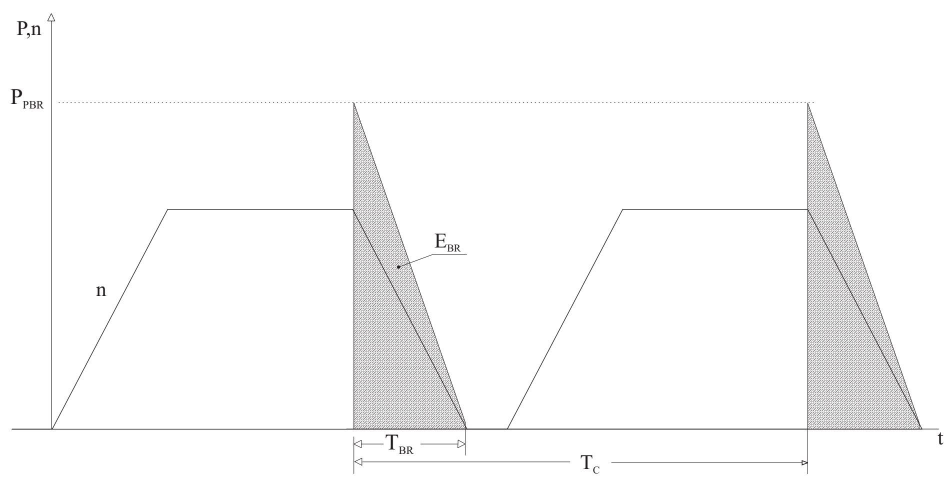
The indication is for a best use of braking resistors when more parallelled resistors are used, case in which the ohmic values indicated in the table should not be available.

ATTENTION!! Units **<u>are not protected against direct short-circuit</u>** between terminals CR, BR. This condition can lead to the destruction of the unit, if external DC fusing is not supplied.

6. STANDARD BRAKING RESISTORS

In order to simplify the choice of the resistor that has to be used, here below the values of the normalized resistors are reported, calculated on a criterion for a typical use.

$\mathbf{P_{OVL}}$	Overload power that can be regenerated by the inverter, equal to the rated power multiplied by factor 1.36 (inverter's overload = I_{cont} x 1.36)
$\mathbf{P_{AVBR}}$	Average power dissipated by the resistor, where the duty cycle is equal to 10%
$\mathbf{E_{BR}}$	Maximum instantaneous energy that the resistor can dissipate
$\mathbf{t_{OVLBR}}$	Maximum continuative braking time in overload conditions ($\mathbf{P_{OVL}}$)
$\mathbf{t_{BR}}$	Maximum continuative braking time at drive rated load conditions
$\mathbf{P_{NBR}}$	Rated continuous power of the resistor which must be equal or greater than the average power $\mathbf{P_{AVBR}}$



The ohmic value of the normalized resistors has been calculated in order to assure the braking current for the limit use of 6KBU300, that is to say a 460Vac supply of the inverter (braking threshold 745Vdc).

AV300	BU300	P_{OVL} [KW]	P_{AVBR} [KW]	E_{BR} [Kwsec]	t_{OVLBR} [sec]	t_{BR} [sec]	P_{NBR} [KW]	RESISTANCES MARK	OHMIC VALUE
3003	…-20	4	0.5	8.8	5	7	0.5	BRR 500T 100R	100 Ω
3005	…-20	6.8	0.7	14	5	7	0.8	BRR 800T 68R	68 Ω
3011	…-20	15	1.5	44	3.5	5	1.3	BRR 1K3T 31R	31 Ω
3015	…-20	20	2	80	8	11	4	BDR 4K0T 23R	23 Ω
3022	... -50	30	3	120	6	8	4	BDR 4K0T 15R4	15.4 Ω
3030	…-50	40	4	70	4	5.5	4	BDR 4K0T 11R6	11.6 Ω
3037	…-50	50	5	180	7.5	10	8	BDR 8K0T 9R2	9.2 Ω
3045	…-50	60	6	220	6	8	8	BDR 8K0T 7R7	7.7 Ω
3055	…-85	75	7.5	140	4.5	6	8	BDR 8K0T 6R2	6.2 Ω
3075	…-85	100	10	2 x 180	7.5	10	2 x 8	2 x BDR 8K0T 9R2	9.2 Ω
3090	2 x …-50	120	12	2 x 220	6	8	2 x 8	2 x BDR 8K0T 7R7	7.7 Ω
3110	2 x …-85	150	15	2 x 140	4.5	6	2 x 8	2 x BDR 8K0T 6R2	6.2 Ω
3132	2 x …-85	180	18	2 x 350	6	8	2 x 12	2 x BDR 12KT 5R1	5.1 Ω
3160	2 x …-85	180 * (218)	18	2 x 350	6	8	2 x 12	2 x BDR 12KT 5R1	5.1 Ω
3250	3 x …-85	272 * (340)	27.2	3 x 350	6	8	3 x 12	3 x BDR 12KT 5R1	5.1 Ω
3315	3 x …-85	272 * (340)	27.2	3 x 350	6	8	3 x 12	3 x BDR 12KT 5R1	5.1 Ω

bu0055

NOTE: the power ratings indicated with (*) have a value lightly below to the one calculated for $\mathbf{P}_{OVL}$ (value between brackets) in order to avoid the introduction of further values of resistors.

Furthermore it must be take into consideration that with high power ratings as these ones, the dynamic performances are generally lower and could even require the use of a regenerative unit on the DC bus.

For 3250 and 3315 sizes, the use of the Line Regen Converter RS-300 should be more convenient.

Every resistor used having different features by the ones above mentioned, must be rated to support the power $\mathbf{P}_{OVL}$ for a time equal to 1/10 of the one of an hypothetical cycle, where after the overload follows a period at zero power for 9/10 of the whole time (10% duty cycle).

$$\mathbf{P}_{OVL} \times 0.1\,T = \mathbf{P}_{AVBR} \times T$$

The maximum duration of the braking time (and consequently the total duration of the cycle) will be determined by the maximum energy pulse $\mathbf{E}_{BR}$ admitted for the resistor during the braking moment, according to the following relation:

$$t_{OVLBR} \text{ and } t_{BR} = \mathbf{0.1\,T} = E_{BR} / P_{OVL}$$

Since the working temperature of the resistor is not known, the resistor itself must be provided with a normally closed thermal dry contact (Klixon) see chapter 3.5.

7. EXTERNAL PANEL MOUNTED DC FUSE

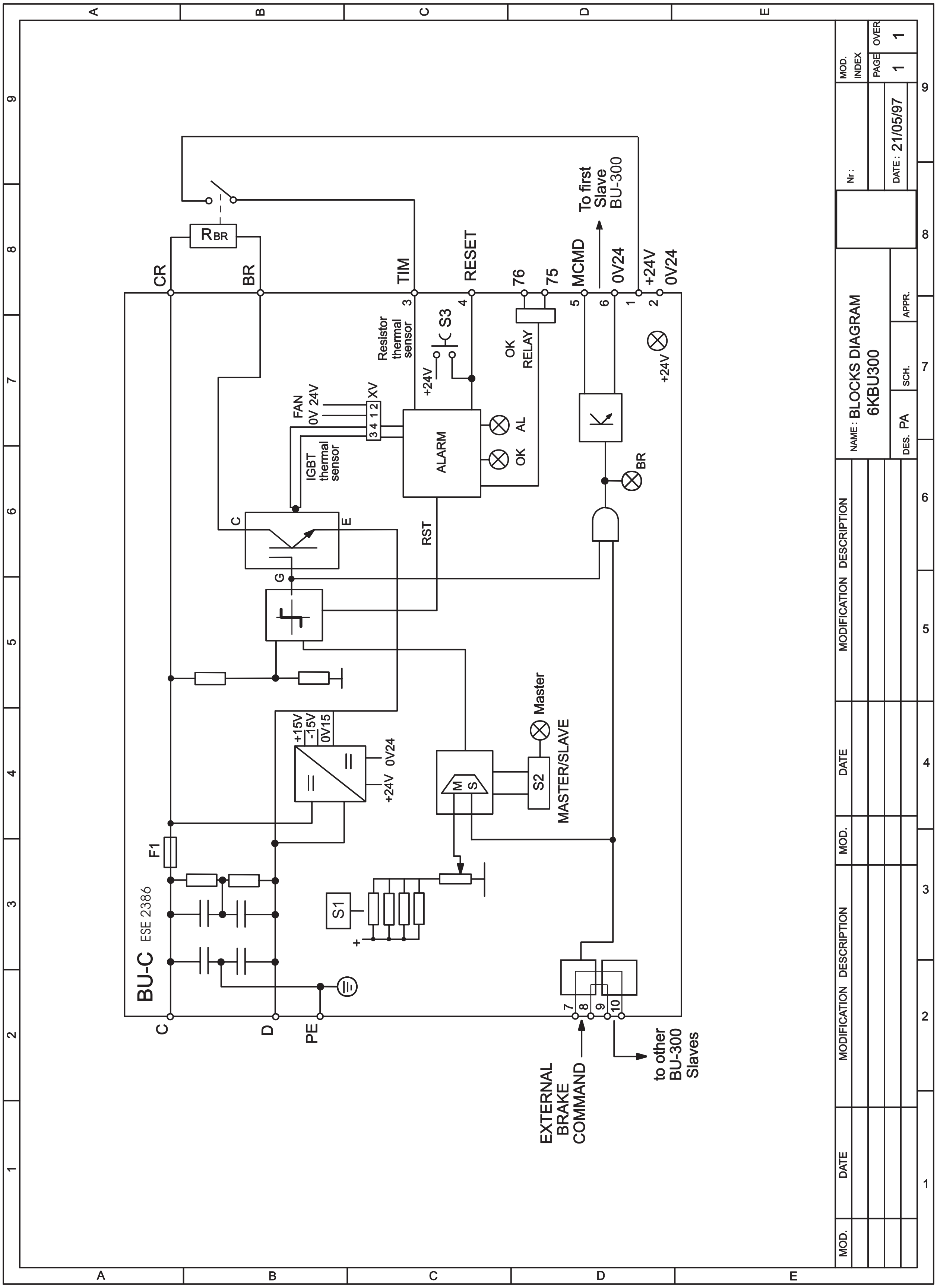
Recommended fuses that must be inserted on terminals C and D.

Model	Fuses
6KBU300-20	A70P80 FWP80
6KBU300-50	A70P150 FWP150
6KBU300-85	A70P200 FWP200

bu0050

Fuse Manufacturers:	A70P	Gold Shawmut
	FWP	Bussman

8. BLOCKS DIAGRAM



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